

ABSTRACT

A nuclear magnetic resonance method and apparatus are disclosed. A sample is provided where the nuclear spin Hamiltonian operator of the component molecules of the sample possess one or more symmetry operations. A quasi equilibrium nuclear spin ensemble state in a sample is created. The quasi equilibrium nuclear spin ensemble state includes at least two manifolds of spin states which transform differently under the symmetry operations of the Hamiltonian and the manifolds having different mean nuclear spin populations. The quasi equilibrium nuclear spin ensemble state is allowed to remain for a time of equal to or substantially greater than $3T_1$, where T_1 is the spin lattice relaxation time. The symmetry operation of the Hamiltonian is broken. A sequence of magnetic fields is applied to generate a nuclear magnetic resonance signal from the sample. The nuclear magnetic resonance signal is detected.